

PACIFIC NORTHWEST CLIMATE IMPACTS RESEARCH CONSORTIUM (CIRC) ANNUAL PROGRESS REPORT 2014

1. **Award Title:** Pacific Northwest Climate Decision Support Consortium (CDSC)
2. **Performance Period** (from previous progress report through May 30, 2014): May 2013 – May 2014

3. **Who are your team members?**

Co-PI Leads

- Philip Mote, Oregon State University (OSU) - Oregon Climate Change Research Institute, College of Oceanic and Atmospheric Sciences Professor
pmote@coas.oregonstate.edu
- Denise Lach, Director, OSU - School of Public Policy, Sociology Program Professor denise.lach@oregonstate.edu

Principal Investigators

- John Abatzoglou, University of Idaho (UI) – climate scenarios, Department of Geography
jabatzoglou@uidaho.edu
- Adell Amos, University of Oregon (UO) – land & water law and policy, School of Law, Environment and Natural Resources Law Program aamos@uoregon.edu
- Jeff Bethel, OSU - Assistant Professor, College of Public Health and Human Science
Jeff.Bethel@oregonstate.edu
- John Bolte, OSU – Envision landscape scenarios; Head, Biological and Ecological Engineering Department john.bolte@oregonstate.edu
- Susan Capalbo, OSU - Department Head, Agricultural and Resource Economics
Susan.Capalbo@oregonstate.edu
- David Hulse, UO – Envision, Department of Landscape Architecture
dhulse@uoregon.edu
- Dennis Lettenmaier, University of Washington (UW) – hydrology, Department of Civil and Environmental Engineering dennisl@u.washington.edu
- Bart Nijssen, UW, hydrology, Department of Civil and Environmental Engineering
nijssen@uw.edu
- Peter Ruggiero, OSU – coastal issues, Department of Geosciences
ruggierp@geo.oregonstate.edu
- Venkataramana Sridhar, BSU – hydrology, Department of Civil Engineering (left BSU and CIRC in January 2014) vsridhar@boisestate.edu
- David Turner, OSU – vegetation modeling, Department of Forest Ecosystems and Society
david.turner@oregonstate.edu

Other participants

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- Cathy Whitlock, Montana State University
- University Extension in Idaho, Oregon, and Washington; and Oregon Sea Grant

Staff

- Allan Branscomb, UO – research assistant, allanb@uoregon.edu
- Meghan Dalton, OSU - faculty research assistant mdalton@coas.oregonstate.edu
- Kathie Dello, OSU - faculty research assistant kdello@coas.oregonstate.edu
- Josh Foster, OSU, university program manager jfoster@coas.oregonstate.edu
- David Rupp, OSU - faculty research assistant drupp@coas.oregonstate.edu
- John Stevenson, OSU, Regional Extension Climate Specialist
jstevenson@coas.oregonstate.edu
- Darrin Sharp, OSU - faculty research assistant dsharp@coas.oregonstate.edu

Post-Doctoral Scholars

- J. Homero Flores-Cervantes, UW (until February 2014) - homefc@uw.edu
- Katherine Hegewisch, UI - khegewisch@uidaho.edu

- Julie Vano, UW until Oct 2013 then OSU; jvano@coas.oregonstate.edu - supported by her own NSF fellowship

Graduate Students

- Matt Bragg, OSU – graduate student braggm@onid.orst.edu
- Christo Brehm, UO – graduate student cbrehm@uoregon.edu
- Jackie Dingfelder, OSU/PSU – graduate student jding2@pdx.edu
- Abby Lute, UI – graduate student - lute8816@vandals.uidaho.edu
- Allison Marshall, OSU - graduate student marshaal@onid.orst.edu
- Katy Serafin, OSU - graduate student serafink@onid.orst.edu
- Adam Walters, UO – graduate student, walters5@uoregon.edu
- Patrick Wingo, OSU- graduate student wingop@onid.orst.edu

4. **What are your new areas of focus or partnerships** that have begun this past year? Please provide some context for why you are expanding into this area or partnership.
 - Tillamook County Coastal Futures Project (TCCF)¹ is developing a transferable approach for projecting the evolving probabilities of coastal flooding and erosion, and the associated evolving community vulnerability, through time along PNW dune-backed shorelines in the context of uncertainty and dearth of information about climate changes and impacts, and adaptation policy alternatives. The project is co-developing, with PNW stakeholders, the information and tools necessary to assess impacts and initiate adaptation strategies over the next several decades in anticipation of potential SLR and changing patterns of storminess. The project is incorporating both coastal flooding and erosion probability and community resilience data using Envision, an established multi-agent model specifically designed to allow exploration of the interactive dynamics and feedbacks of coupled natural and human systems in a spatially explicit, scenario-driven, policy-centric framework. The project also is build coastal ‘Knowledge to Action Networks’ (KTANs) consisting of collaborative teams of stakeholders, researchers, and outreach specialists who will co-produce knowledge to inform climate-resilient strategies in select PNW coastal counties like Tillamook. The primary beneficiaries of the findings of this project include coastal resource, land-use, and emergency managers, state and federal agencies, as well as the general public. Specific partners include: Neskowin Coastal Hazards Committee; Tillamook County Offices of Community Development and Planning; Tillamook County Commissioners; Oregon Coastal Processes and Hazard Working Group; Oregon Sea Grant; Oregon State Parks and Recreation Department; Oregon Department of Land Conservation and Development; Oregon Department of Transportation; and Washington Department of Ecology plus city managers and mayors, community advisory committees, property owners, developers, and regional solutions groups. Activities have included post-meeting KTAN surveys to characterize the stakeholder groups and identify additional information gaps.
 - We are augmenting the CIRC-CSC project on Integrated Scenarios (more below) through funding from the Bonneville Power Administration. We will be adding a glacier simulation component to the hydrologic modeling work recently completed under the Integrated Scenarios project. The work will be conducted with the engagement of stakeholders including BPA and the Columbia River Basin Management Joint Operating Committee (RMJOC-composed of BPA, Army Corps of Engineers, and Bureau of Reclamation). We are doing this work in order to support the climate change discussions as part of the US-Canada Columbia River Treaty updates in 2015 and beyond, and

¹ Note this CIRC project builds on the **NOAA CPO Coastal and Ocean Climate Applications (COCA) Program** project: “Incorporating uncertainty associated with climate change into coastal vulnerability assessments: toward developing an adaptive capacity.”

continue to ensure that CIRC is positioned to be a resource for climate change work in that process.

- Adell Amos (UO) carried out research articulating the respective roles of federal and state water law and policy as they pertain to water scarcity in the Willamette River Basin. This effort has resulted in a manuscript for submission to the Kansas Law Review.
 - Benton County (Oregon) public health and adaptation planning: concluded first phase of Benton County Climate Adaptation Planning process by participating in a department wide presentation to Benton County Commissioners June 2014. Attending also were representatives from the Oregon Health Authority (OHA) and the US Centers for Disease Control (CDC) Building Resilience Against Climate Effects (BRACE) Program of which Benton County is one of 24 showcase counties. The County received recognition from CDC as a leader in local climate and health adaptation planning including for collaboration with OSU/CIRC. The Corvallis Gazette-Times recently carried a front-page top-fold article on the effort.
5. Please provide a list of up to 5 **research findings** – Please try to include examples that span disciplinary and interdisciplinary work. Examples might be: a) dust-on-snow reduces Colorado River runoff by 5%, or b) analysis revealing the presence or absence of adaptive capacity in legal and policy frameworks for managing resources.
- Integrated Scenarios of the Future Northwest Environment: *Climate results* - In the Northwest, temperatures will likely increase 2-15 degrees Fahrenheit by 2100. Models projecting lowest rates of future warming generally performed poorly in 20th century simulations. The region's winters may become slightly wetter and its summers may be drier; unlike the temperature changes, however, these may not be clearly different from conditions observed in the past century. *Hydrologic results* - Snowpack will likely decrease substantially, and snowmelt runoff may occur earlier in the year leading to increased winter runoff, earlier and decreased spring runoff, and decreased summer soil moisture content and runoff. *Vegetation results* - Forest types are expected to shift towards mixed evergreen-deciduous types, better adapted to warmer drier conditions. For example, coastal maritime evergreen forests adapted to cool conditions because of the proximity of the ocean are projected to shift to subtropical mixed forests when disturbances allow their replacement. Wildfires will most likely become more frequent and severe over the next several decades since western forests have abundant fuels currently too moist to ignite but becoming more flammable when longer drier summers become the norm. Forest productivity (e.g. wood production) will likely increase at higher elevations currently limited by cooler temperatures and short growing season, but will be limited across the region by greater evaporative demand and late summer soil drying. The distribution of Douglas fir will shift upward in elevation as drought stress increases at low elevation sites. Climate can drive changes in forest types through changing productivity, competition for water, and disturbance (like fires).
 - In a multi-RISA effort, Vano et al. (BAMS 2014) assess sources of uncertainty in projections of Colorado River streamflow, finding that the variance in projected streamflow (declines of 10-45% in mid-21st century) originates from four sources: the selection of GCMs and scenarios; ability of models to simulate properly the high-elevation runoff; sensitivities of hydrologic models to changes in precipitation and temperature; and the methods used to statistically downscale the GCMs.
 - Building on that effort, CIRC investigators led by Dr. Vano created a “poor man's” approach to hydrological modeling (manuscript in review): perturbing the climate inputs to a hydrologic model one month at a time, by small amounts, to gauge the responses.

This approach faithfully reproduces hydrographs from complete simulations for quite large climate perturbations - up to those expected by mid 21st century, with less fidelity in late 21st century. Using this approach, an arbitrarily large range of climate scenarios can be investigated very efficiently. The success of this approach depends on linearity, superposition, and physical management context (not one size fits all). Water managers have responded favorably to this modeling approach and the results, and it was used in conjunction with the Rupp et al. (2013) model evaluation to select three GCM scenarios for Willamette Water 2100.

- Definition of water scarcity. Jaeger et al. (2013) argue that biophysical and socioeconomic definitions of water scarcity are fairly different, and a changing climate is motivation for improving the definitions. Starting with a simple but robust definition—the marginal value of a unit of water—the paper highlights key aspects of water scarcity and illustrates its many biophysical and socioeconomic determinants. Four main results follow: First, water scarcity varies greatly across location, time, and a multitude of uses that are valued either directly or indirectly by society. Second, water scarcity is fundamentally a normative, anthropocentric concept and, thus, can and should be distinguished from the related, purely descriptive notion of water deficit. While such an anthropocentric perspective may seem limiting, it has the potential to encompass the vast range of interests that society has in water. Third, our ability to understand and anticipate changes in water scarcity requires distinguishing between the factors that affect the value or benefits of water from those affecting the costs of transforming water in space, time and form. Finally, this robust and rigorous definition of water scarcity will facilitate better communication and understanding for both policymakers and scientists.
6. Please provide a list of up to 5 outreach activities that you have undertaken in the past year. OPTIONAL: If applicable, please share the outcomes of these activities.
- The Tillamook County ‘Knowledge to Action Network’ (KTAN) met several times for engagement in workshops and informal meetings during September and October 2013, and March, April, and June 2014. Perspectives were collected from private citizens, county planners, and state representatives for land development and the parks department. Over the course of these meetings, draft scenario narratives were formulated and refined via stakeholder interactions combining climate change projects, local “on the ground” information, and relevant policy scenarios to ensure accurate reflection of stakeholder concerns and possible actionable solutions. These interactions resulted in various “co-produced” storylines innovatively displayed on easy to understand posters using simulated visuals, graphs, charts, text, and color-coding of impacts and risks (see TCCF webpage June 2014 Meeting for copies of the posters). A “Development Storyline” showed how coastal development would change over time, and how implementation of hazard alleviation techniques would alter development. A “Property Risk Storyline” showed how buildings would be impacted by coastal flood and erosion hazards in the future based on “Laissez-Faire” and “Hold-the-Line” actions, when homeowners would need backshore protection structures (BPS) to protect their property, and how costs associated with protecting property on the coast would change over time. A “Public Good Storyline” showed how often the beach becomes inaccessible because of flooding and how much money it would cost to keep the beach accessible, as well as how roads would be impacted by coastal hazards.
 - Willamette Water 2100 (NSF-funded project on water sustainability and climate) stakeholder meeting: CIRC PIs co-led the organization of, attended and presented at the March 18, 2014 Stakeholder Meeting, to report preliminary reference case scenario results and seek stakeholder feedback. CIRC staff are working on several aspects of

Willamette Water 2100, including climate data and scenarios selection, data visualization and analysis, and application of water law to modeling.

- Integrated Scenarios - April 17, 2014 Stakeholder Workshop. As this CIRC/CSC-funded project comes to a close, CIRC PIs held a workshop attended by about 75 in the room and 150 remotely. We presented the main results and provided instruction on accessing and understanding the data. The products of the Integrated Scenarios work are freely available datasets and visualizations that can be used to address scientific and management questions. These datasets are compatible with other hydrological and ecological modeling efforts and represent a next-generation climate change framework for scientists and managers. Other outreach includes
 - our climate data webpage (<http://maca.northwestknowledge.net>) which provides visualizations, data, and guidance on how to use the climate data
 - provided customized climate datasets and advice to approximately 30 scientists with small geographical regions of interest within the Western USA.
 - built a web site to illustrate the downscaled climate scenarios and vegetation modeling time series results summarized by ecoregions: <http://consbio.webfactional.com/integratedscenarios/>
- Drought 2013-14:
 - CIRC co-hosted an Inland Northwest Drought Forum in Boise, ID with NIDIS and the Idaho Department of Water Resources in October 2013. The purpose was to get information out about the evolving dry conditions as well as strategies for adapting to drought. The forum was attended by ~90 water managers and users from Oregon and Idaho.
 - Drought Webinar briefings were held in March and April 2014 related to Oregon and the PNW
 - US Senator Jeff Merkley (D-OR) specifically requested a briefing from CIRC and Oregon Climate Service staff on the drought, which was held in Eugene OR on April 4, 2014. Kathie Dello led the effort and invited key staff from Oregon Department of Water Resources.
 - CIRC and the Oregon Climate Service are developing a joint drought website
 - Further development and deployment of UW Drought Monitor - also, presentation at AGU on “Coping with drought: A High Resolution Drought Monitoring and Prediction System for the Pacific Northwest” <http://adsabs.harvard.edu/abs/2013AGUFM.H21A1006X>
- National Climate Assessment for the NW:
 - Completed NW Chapter of the National Climate Assessment
 - Gave numerous public presentations about NCA and the NW regional climate assessment published by Island Press
- Other:
 - CIRCulator Newsletter: the CIRCulator summarizing 5-7 cutting edge climate science publications and findings, featuring CIRC researchers, and related activities for the PNW, has now been in continuous monthly publication since April 2012. A recent subscriber evaluation produced positive reviews on content and regularity
 - upgrades to CIRC website have been accomplished and social media presence has been established including Facebook, Twitter, Google+, RSS and other platforms
 - Several CIRC presentations at the 4th Pacific Northwest Climate Science Conference September 2013, including a special session on the Integrated

Scenarios project, and Katy Serafin who won the award for best student presentation.

7. Please provide a list of **key publications** from the past year - We are seeking ~ 5 publications, give or take a few, to be highlighted on the CPO webpage. These can be either non-peer reviewed or peer-reviewed. For peer-reviewed publications, please list either **published** or in **press**, but **not** “in review”. For non peer-reviewed publications, please provide a hyperlink or webpage wherever possible. (You may include a more comprehensive list of publications as an appendix.)
 - Vano, Julie A., and Coauthors, 2014: Understanding Uncertainties in Future Colorado River Streamflow. *Bull. Amer. Meteor. Soc.*, 95, 59–78. doi: [10.1175/BAMS-D-12-00228.1](https://doi.org/10.1175/BAMS-D-12-00228.1)
 - *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities* (Dalton et al.) - assesses the state of knowledge about key climate impacts and consequences to various sectors and communities in the Pacific Northwest (developed to accompany the 2014 National Climate Assessment) occri.net/reports
 - Abatzoglou, J. T., D. E. Rupp, P. W. Mote. 2014. Seasonal climate variability and change in the Pacific Northwest of the United States. *Journal of Climate*, (27), 2125-2142, doi: [10.1175/JCLI-D-13-00218.1](https://doi.org/10.1175/JCLI-D-13-00218.1).
 - Kruk, M.C., Marra, J.J., Merrifield, M., Ruggiero, P. Atkinson, D., Levinson, D., and Lander, M., 2013. Pacific Storms Climatology Products (PSCP): Understanding Extreme Events, *Bulletin of the American Meteorological Society*. DOI: 10.1175/BAMS-D-11-00075.1

8. Please provide up to 3 narrative **examples** from the past year of plans, policies, strategies, tools, agreements, etc. that were proposed, adopted, and/or implemented as a result of RISA work.

Piloting Utility Modeling Applications (PUMA) - CIRC has been assisting the water utilities of Seattle and Portland as they update their climate change impacts assessments. This effort differs from previous efforts in three significant ways: (1) CIRC is investigating a set of specific climate change questions posed by the utilities themselves (e.g., based on performance and other factors, which GCMs are best suited for use in the Utilities' own studies; how will climate change affect the timing of fall rains, likelihood of forest fires in their watersheds, and changing risk of flooding); (2) CIRC is developing and expanding in-house expertise and climate-hydrologic modeling capacity for Portland Water Bureau by testing and selecting an appropriate hydrologic model that will enable the Bureau to conduct its own climate change analyses; and (3) we have performed specialized statistical downscaling for application to the Utilities' own watershed modeling.

City of Eugene Climate Vulnerability Assessment (CVA): concluded first phase of Eugene's Hazard Mitigation Plan update by participating in evaluation of draft report on hazards and adaptive capacity (including for climate change and extreme weather) covering sectors including: Drinking Water; Health Care and Public Health; Sanitary Sewer; Electricity; Natural Systems; Housing; Food; Drinking Water; Transportation; Stormwater; Communications; and Public Safety. Over 150 departmental employees interviewed during over 50 hours of group interviews.

UW Drought Monitor System for the Pacific Northwest and California: CIRC made this high-resolution PNW drought monitor operational (including daily updates based on stakeholder interest and input); added California to help drought discussions and planning there; and included a seasonal forecast component.

9. OPTIONAL: How do you measure success? Please provide information on 1-3 metrics or indicators that you use to evaluate your projects and/or program. These will be compiled into a RISA-wide resource to enable sharing among RISAs.
10. Please fill out the attached project database template for projects that meet all of the following criteria (NOTE: These criteria are generally a judgment call on the part of the Principal Investigator(s) and/or the Program Managers and do not require extensive analysis. Criteria should NOT be listed in database.):
- a. Core RISA projects – Determined by one or more of the following:
 - i. RISA investigator is leading the effort
 - ii. RISA is primary source of funding
 - iii. RISA capacity is critical to the project (e.g. Regional Chapters/Technical Inputs of the NCA)
 - b. Current projects – Determined by one or more of the following:
 - i. Recently completed (i.e. finished within the last six months)
 - ii. Ongoing (i.e. initiated, but not completed)
 - iii. Planned (i.e. funded but not started)

PUBLICATIONS

2013-2014 Publications

- Abatzoglou, J. T., D. E. Rupp, P. W. Mote. 2014. Seasonal climate variability and change in the Pacific Northwest of the United States. *Journal of Climate*, (27), 2125-2142, doi: 10.1175/JCLI-D-13-00218.1.
- Ashfaq, M., S. Ghosh, S-C Kao, LC Bowling, P Mote, SA Rauscher, and NS Diffenbaugh, 2013: Near-term Acceleration of Hydroclimatic Change in the Western US. *J. Geophys. Res. Atmos.*, 118, 10,676–10,693, doi:10.1002/jgrd.50816.
- Comiso, J., D.G. Vaughan, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen, and T. Zhang, 2013: Observations: the cryosphere. Chapter 4 in *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the *Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T., D. Qin, et al., (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Dalton, M., P.W. Mote, and A.K. Snover, eds., 2013: *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities*. 224 pp. Island Press.
- Hoekema, D. J., and V. Sridhar, 2013. A System Dynamics Model for Conjunctive Management of Water Resources in the Snake River Basin. *Journal of the American Water Resources Association (JAWRA)* 49(6):1327-1350. DOI: 10.1111/jawr.12092
- Jaeger, W.K., A.J. Plantinga, H. Chang, K. Dello, G. Grant, D. Hulse, J. McDonnell, S. Lancaster, H. Moradkhani A.T. Morzillo, P. Mote, A. Nolin, M. Santelmann, J. Wu. 2013 in press. Toward a formal definition of water scarcity in natural-human systems, *Water Resources Research*, 49, 4506–4517, doi:10.1002/wrcr.20249.
- Jaksa, W.T., V. Sridhar, J. L. Huntington and M. Khanal (2013). Evaluation of the Complementary Relationship using Noah Land Surface Model and North American Regional Reanalysis (NARR) Data to Estimate Evapotranspiration in Semiarid Ecosystems, *Journal of Hydrometeorology*, Vol. 14, Issue 1, 345-359, Feb 2013 DOI: 10.1175/JHM-D-11-067.1
- Komar, P.D., J.C. Allan and P. Ruggiero, 2013. U.S. Pacific Northwest Coastal Hazards: Tectonic and Climate Controls, Chapter 21 in *Coastal Hazards*, edited by C. Finkl, 587-674.
- Kruk, M.C., Marra, J.J., Merrifield, M., Ruggiero, P. Atkinson, D., Levinson, D., and Lander, M., 2013. Pacific Storms Climatology Products (PSCP): Understanding Extreme Events, *Bulletin of the American Meteorological Society*. DOI: 10.1175/BAMS-D-11-00075.1
- Lute, A.C. and J.T. Abatzoglou, 2014, Role of extreme snowfall events in interannual variability of snowfall accumulation in the western United States, *Water Resources Research*, 50, doi:10.1002/2013WR014465.
- Marshall, A., D. Lach, J. Stevenson, J. Bolte, J. Koch. (Accepted) Collaborative modeling to assess climate impacts on water resources in the Big Wood Basin, Idaho. In *Including Stakeholders in Environmental Modeling: Considerations, Methods and Applications*. Springer Publishing.
- Mauger, G. S., K. A. Bumbaco, G. J. Hakim, and P. W. Mote, 2013: Optimal design of a climatological network: Beyond practical considerations, *Geosci. Instrum. Method. Data Syst. Discuss.*, 3, 193-219, doi: 10.5194/ gid-3-193-2013.
- Moss, R.H., G. A. Meehl, M.C. Lemos, J.B. Smith, J.R. Arnold, J.C. Arnott, D. Behar, G.P. Brasseur, S.B. Broomell, A.J. Busalacchi, S. Dessai, K.L. Ebi, J.A. Edmonds, J. Furlow, L. Goddard, H.C. Hartmann, J.W. Hurrell, J.W. Katzenberger, D.M. Liverman, P. Mote, S. C. Moser, A. Kumar, R. S. Pulwarty, E. A. Seyller, B. L. Turner, W. M. Washington, T. J. Wilbanks, 2013: Hell and High Water: Application-Relevant Climate Adaptation Science. *Science*, doi: 10.1126/science.1239569.

- Mote, P., J. Abatzoglou, and K. Kunkel, 2013: Climate change in the Northwest. Chapter 2 in Dalton, M., P.W. Mote, and A.K. Snover, eds., 2013: *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities*. 224 pp. Island Press.
- Mote, P., A.K. Snover, S. Capalbo, S.D. Eigenbrode, P. Glick, J. Littell, R. Raymondi, and S. Reeder, 2014: The Northwest. Chapter 21 in the *US National Climate Assessment*.
- Ruggiero, P., 2013. Is the intensifying wave climate of the U.S. Pacific Northwest increasing flooding and erosion risk faster than sea level rise? *Journal of Waterway, Port, Coastal, and Ocean Engineering*. 10.1061/(ASCE)WW.1943-5460.0000172
- Rupp, D.E., J. Abatzoglou, K.C. Hegewisch, and P.W. Mote, 2013: Evaluation of CMIP5 20th century climate simulations for the Pacific Northwest US. *J. Geophys. Res.*, doi: 10.1002/jgrd.50843.
- Rupp, D.E., P.W. Mote, N.L. Bindoff, P.A. Stott, D.A. Robinson, 2013: Detection and Attribution of Observed Changes in Northern Hemisphere Spring Snow Cover. *J. Climate*, 26, 6904–6914. doi: <http://dx.doi.org/10.1175/JCLI-D-12-00563.1>
- Rupp, D.E., P.W. Mote, F.E.L. Otto, and M.R. Allen, 2013: The human influence on the probability of low precipitation in the central United States in 2012. [in *Explaining Extreme Events of 2012 from a Climate Perspective*"]. *Bull. Amer. Meteorol. Soc.*, 94 (9), S2-S6.
- Stevenson, J., M. Crimmins, J. Whitehead, C. Fraisse, J. Brugger, (Accepted) Connecting Information with Practical Uses: Extension and the NOAA RISA Program. In *Climate in Context*, Wiley and Sons.
- Vano, J.A. and D.P. Lettenmaier. 2014: A sensitivity-based approach to evaluating future changes in Colorado River Discharge, *Climatic Change*, 122:4, 621-634, doi: [10.1007/s10584-013-1023-x](http://dx.doi.org/10.1007/s10584-013-1023-x)
- Vano, Julie A., and Coauthors, 2014: Understanding Uncertainties in Future Colorado River Streamflow. *Bull. Amer. Meteor. Soc.*, 95, 59–78. doi: <http://dx.doi.org/10.1175/BAMS-D-12-00228.1>